REMARKS

This Amendment is presented in response to the Examiner's Office Action mailed July 18, 2002. Claims 1 and 6-12 are amended, and new claims 15 and 16 are added. For the convenience and reference of the Examiner, the remarks of the Applicant are presented in the order in which the corresponding issues were raised in the Office Action.

In connection with the matters contemplated herein, Applicant respectfully notes that the following discussion should not be construed to constitute an exhaustive enumeration of the distinctions between the claims of the present application and the references cited by the Examiner. Instead, such distinctions are presented solely by way of example. Consistent with the foregoing, the discussion herein is not intended, and should not be construed, to prejudice or foreclose contemporaneous or future consideration, by the Applicant, of additional or alternative distinctions between the claims of the present application and the references cited by the Examiner, and/or the merits of additional or alternative arguments.

I. Objection to the Specification

The Examiner has objected to the Summary section (referred to in the application as the 'Disclosure of the Invention') as being a 'rehash of the claims.' Responsive to such objection, Applicant has submitted herewith a revised Disclosure of the Invention.

II. Claim Rejections Under 35 U.S.C. § 103(a)

Applicant respectfully notes that in order to establish a *prima facie* case of obviousness, it is the burden of the Examiner to demonstrate that three criteria are met: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally

available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; second, there must be a reasonable expectation of success; and third, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See* M.P.E.P. § 2143.

With reference now to the specific obviousness rejections, the Examiner has rejected claims 1, 7-9, 11 and 12 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,809,083 issued to Wright ("*Wright*"). For at least the reasons outlined below, Applicant respectfully traverses the rejection regarding claims 1, 7-9, 11 and 12.

a. Alleged Obviousness of Claims 1, 7 and 12

In particular, claims 1, 7 and 12 specify, among other things, that "the power of the data symbols and pilot symbols is controlled on a slot by slot basis." In relation to this limitation, the Examiner has alleged with respect to claim 7 (which also includes the aforementioned limitation) that "Wright allows the data and pilot symbol amplitudes to be varied by each differentially encoded pilot word where each pilot word may be seen as a slot." Thus, if the receiving side knows the pattern of the pilot symbols whose amplitudes are different from each other, the transmitting side can transmit the pilot symbols whose amplitudes are different from each other, and the receiving side can receive the pilot symbols and perform channel estimation by comparing the received pilot symbols with the known pattern.

Notwithstanding the contentions of the Examiner, Applicant respectfully submits that such a situation occurs where no power transmission control is performed and, accordingly, is inconsistent with cases such as are contemplated by claims 1, 7 and 12 which, as noted above, specify that "the power of the data symbols and pilot symbols is controlled on a slot by slot

basis." Rather, where power transmission control is performed, the power of the pilot symbols fluctuates in the multiple slots, and channel estimation error is incurred as a result of such power fluctuations.

For at least the foregoing reasons, Applicant respectfully submits that *Wright* fails to teach or suggest the limitation of claims 1, 7 and 12 direct to "[controlling] the power of the data symbols and pilot symbols is controlled on a slot by slot basis," and more generally, fails to teach or suggest transmission power control. Applicant thus further submits that the Examiner has failed to make out a *prima facie* case of obviousness with respect to claims 1, 7 and 12 (as herein amended) at least because the art reference cited by the Examiner fails to teach or suggest all the claim limitations.

In view of the foregoing, Applicant respectfully submits that the rejection of claims 1, 7 and 12 has been overcome and should be withdrawn.

b. Alleged Obviousness of Claims 8, 9 and 11

The Examiner has alleged with respect to claim 8, that "Wright allows for varying configurations of the differentially encoded pilot words and thus, would allow for the number of pilot symbols and data symbols to be the same within each differentially encoded pilot word."

Applicant notes that claim 8 has been amended herein to claim dependency to any of one claims 1-3 and 15. As Applicant believes claim 1 to be non-obvious, for at least the reasons stated herein, Applicant respectfully submits that claim 8 is likewise nonobvious when dependent from claim 1 since, by definition, claim 8 would include all the limitations of claim 1.

Moreover, the Examiner has conceded that as to claims 2 and 3, among others, "CDMA receivers or transceivers incorporating combined symbol sequence processing that includes data

symbols and pilot symbols where the combined symbol sequence is spread and despread as a unit were neither found, suggested, nor made evident by the prior art." In view of this concession by the Examiner, Applicant further submits that claim 8, as dependent from either of claims 2 or 3, is likewise non-obvious.

As noted above, the dependency of claim 8 has also been modified to refer to newly added claim 15 which requires, among other things, "when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks are generated from (n-K+1)th slot to (n+K)th slot in the combined symbol sequence, where K is a natural number." With regard to the presence of this same limitation in claim 10, the Examiner has noted that "the pilot blocks are generated in manner not found, suggested, nor made evident by the prior art." Applicant accordingly submits that claim 8, as dependent from new claim 15, is non-obvious.

For at least the foregoing reasons, Applicant respectfully submits that the rejection of claim 8 has been overcome and should be withdrawn. Moreover, as claims 9 and 11 have been amended herein to indicate dependency from claims 1-3 and 15, Applicant submits that the preceding discussion concerning claim 8 is equally germane to claims 9 and 11. Applicant thus further submits that the rejection of those claims has likewise been overcome and should be withdrawn.

III. Objection to Claim 10

The Examiner has objected to claim 10 as being dependent upon a rejected base claim, but has suggested that claim 10 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. In this regard, the Examiner has

stated that "Regarding claim 10, the pilot blocks are generated in manner not found, suggested, nor made evident by the prior art."

In any event, Applicant respectfully submits that claim 10, amended herein to indicate dependency from any of claims 1-3 is now in allowable condition, for at least the reasons outlined above in connection with the discussion of claims 8, 9 and 11.

IV. New Claims 15 and 16

Applicant also submits that new claims 15 and 16 are distinguished over the cited prior art. Among other things, claims 15 and 16 require "when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks are generated from (n-K+1)th slot to (n+K)th slot in the combined symbol sequence, where K is a natural number." As noted herein, the Examiner has conceded that the such "pilot blocks are generated in manner not found, suggested, nor made evident by the prior art."

In this connection, Applicant respectfully submits that patentability of the new and amended claims submitted herewith does not hinge on the presence of any particular limitation. Rather, Applicant respectfully submits that each of the now pending claims, considered in its respective entirety, patentably distinguishes over the references cited by the Examiner.

CONCLUSION

In view of the discussion and amendments submitted herein, Applicant respectfully submits that each of the pending claims 1-16 are now in condition for allowance. Therefore, reconsideration of the rejections is requested and allowance of those claims is respectfully solicited. In the event that the Examiner finds any remaining impediment to a prompt allowance of this application that could be clarified in a telephonic interview, the Examiner is respectfully requested to initiate the same with the undersigned attorney.

Dated this 14th day of January, 2003.

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Version with Markings to Show Changes

IN THE SPECIFICATION:

The present invention is implemented to solve the foregoing problems. It is therefore an object of the present invention to achieve highly accurate channel estimation by obtaining highly accurate channel estimates by assigning appropriate weighting factors to individual data symbols in the same slot, and by calculating a sum of appropriately weighted pilot symbols in respective slots before and after the slot the data symbols belong to, when carrying out the channel estimation of the data symbols.

The highly accurate channel estimation and compensation for channel fluctuations in the data symbols based on the channel estimation make it possible for the absolute coherent detection to decide the absolute phase of each data symbol even in the Rayleigh fading environment, which can reduce the SNIR for achieving desired receiving quality (receiving error rate). This can reduce the transmission power, and increase the capacity of a system in terms of the number of simultaneous subscribers.

In order to accomplish the object aforementioned, [according to the invention as claimed in claim 1,] in the first aspect of the present invention, there is provided a channel estimation unit for obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, compris[es]ing:

means for locating the pilot symbols in the combined symbol sequence;

means for generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result; and

means for obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks,

wherein a magnitude of weighting differs between at least two data symbols in each slot, and

the power of the data symbols and pilot symbols is controlled on a slot by slot basis.

[According to the invention as claimed in claim 2,] In the second aspect of the present invention, there is provided a CDMA receiver which receives a combined symbol sequence that is spread, has a plurality of slots, and includes data symbols and pilot symbols, and which generates a data sequence, compris[es]ing:

means for receiving the spread combined symbol sequence;

means for generating a combined symbol sequence by despreading the spread combined symbol sequence;

means for locating the pilot symbols in the combined symbol sequence;

means for generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result;

means for obtaining channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks;

means for obtaining a data symbol sequence by eliminating the pilot symbols from the combined symbol sequence in accordance with the located result;

means for compensating for channel fluctuations in the data symbol sequence by using the channel estimates of the data symbols; and

means for generating the data sequence by demodulating the data symbol sequence compensated for,

wherein a magnitude of weighting differs between at least two data symbols in each slot.

[According to the invention as claimed in claim 3,] In the third aspect of the present invention, there is provided a CDMA transceiver including a transmitting processor and a receiving processor, compris[es]ing:

means for generating a data symbol sequence by modulating a data sequence;

means for generating a combined symbol sequence by inserting pilot symbols into the data symbol sequence;

means for generating a spread combined symbol sequence by spreading the combined symbol sequence; and

means for transmitting the spread combined symbol sequence,

wherein the spread combined symbol sequence to be transmitted has a plurality of slots and the receiving processor comprises:

means for receiving the spread combined symbol sequence;

means for generating the combined symbol sequence by despreading the spread combined symbol sequence;

means for locating the pilot symbols in the combined symbol sequence;

means for generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result;

means for obtaining channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks;

means for obtaining a data symbol sequence by eliminating the pilot symbols from the combined symbol sequence in accordance with the located result;

means for compensating for channel fluctuations in the data symbol sequence by using the channel estimates of the data symbols; and

means for generating the data sequence by demodulating the data symbol sequence compensated for,

wherein a magnitude of weighting differs between at least two data symbols in each slot.

[According to the invention as claimed in claim 4, in the CDMA transceiver as claimed in claim 3,] Here the transmitting processor may further comprise[s] means for inserting into the data symbol sequence a power control symbol sequence for controlling power of the data symbols and pilot symbols.

[According to the invention as claimed in claim 5, in the CDMA transceiver as claimed in claim 4,] Here the receiving processor may further comprise[s] means for measuring from the pilot symbols a signal-to-noise and interference power ratio, and for generating the power control symbol sequence from the signal-to-noise and interference power ratio.

[According to the invention as claimed in claim 6, in the CDMA transceiver as claimed in any one of claims 3-5,] Here the receiving processor may further comprise[s] means for extracting, from the data symbol sequence compensated for, the power control symbol sequence for controlling power of the data symbols and pilot symbols, and the means for transmitting the spread combined symbol sequence transmits the spread combined symbol sequence in accordance with the power control symbol sequence.

[According to the invention as claimed in claim 7, in the equipment as claimed in any one of claims 1-6,] Here the power of the data symbols and pilot symbols [is] may be controlled on a slot by slot basis.

[According to the invention as claimed in claim 8, in the equipment as claimed in any one of claims 1-7,] Here the number of data symbols included in each slot of the combined symbol sequence [is] may be the same, and the number of pilot symbols included in each slot of the combined symbol sequence [is] may be the same.

[According to the invention as claimed in claim 9, in the equipment as claimed in any one of claims 1-8,] Here the pilot blocks each may consist of all the pilot symbols in each slot.

[According to the invention as claimed in claim 10, in the equipment as claimed in any one of claims 1-9,] Here when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks [are] may be generated from (n-K+1)th slot to (n+K)th slot in the combined symbol sequence, where K is a natural number.

[According to the invention as claimed in claim 11, in the equipment as claimed in any one of claims 1-10,] Here the pilot blocks closer to the data symbol with which the channel estimate is to be obtained may have a greater weight.

[According to the invention as claimed in claim 12,] In the fourth aspect of the present invention, there is provided a channel estimation method of obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, compris[es]ing the steps of:

locating the pilot symbols in the combined symbol sequence;

generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result; and

obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks

wherein a magnitude of weighting differs between at least two data symbols in each slot[.], and

the power of the data symbols and pilot symbols is controlled on a slot by slot basis.

[According to the invention as claimed in claim 13,] In the fifth aspect of the present invention, there is provided a CDMA receiving method of generating a data sequence by receiving a combined symbol sequence that has a plurality of slots, includes data symbols and pilot symbols, and is spread, compris[es]ing the steps of:

receiving the spread combined symbol sequence;

generating the combined symbol sequence by despreading the spread combined symbol sequence;

locating the pilot symbols in the combined symbol sequence;

generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result;

obtaining channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks;

obtaining a data symbol sequence by eliminating the pilot symbols from the combined symbol sequence in accordance with the located result;

compensating for channel fluctuations in the data symbol sequence by using the channel estimates of the data symbols; and

generating the data sequence by demodulating the data symbol sequence compensated for,

wherein a magnitude of weighting differs between at least two data symbols in each slot.

[According to the invention as claimed in claim 14,] In the sixth aspect of the present invention, there is provided a CDMA transmitting and receiving method compris[es]ing the steps of:

on a transmitting side,

generating a data symbol sequence by modulating a data sequence;

generating a combined symbol sequence by inserting pilot symbols into the data symbol sequence;

generating a spread combined symbol sequence by spreading the combined symbol sequence; and

transmitting the spread combined symbol sequence,

wherein the spread combined symbol sequence to be transmitted has a plurality of slots, and on a receiving side,

receiving the spread combined symbol sequence;

generating the combined symbol sequence by despreading the spread combined symbol sequence;

locating the pilot symbols in the combined symbol sequence;

generating pilot blocks by extracting the pilot symbols from two ore more slots in the combined symbol sequence in accordance with a located result;

obtaining channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks;

obtaining a data symbol sequence by eliminating the pilot symbols from the combined symbol sequence in accordance with the located result;

compensating for channel fluctuations in the data symbol sequence by using the channel estimates of the data symbols; and

generating the data sequences by demodulating the data symbol sequence compensated for,

wherein a magnitude of weighting differs between at least two data symbols in each slot.

In the seventh aspect of the present invention, there is provided a channel estimation unit for obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, said channel estimation unit comprising:

means for locating the pilot symbols in the combined symbol sequence;

means for generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result; and

means for obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks,

wherein a magnitude of weighting differs between at least two data symbols in each slot, and when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks are generated from (n-K+1)th slot to (n+K)th slot in the combined symbol sequence, where K is a natural number.

In the eighth aspect of the present invention, there is provided a channel estimation method of obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, said channel estimation method comprising the steps of:

locating the pilot symbols in the combined symbol sequence;

generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result; and

obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks,

wherein a magnitude of weighting differs between at least two data symbols in each slot, and when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks are generated from (n-K+1)th slot to (n+k)th slot in the combined symbol sequence, where K is a natural number.

IN THE CLAIMS:

Claims 1 and 6-12 have been amended as follows:

1. (**Amended**) A channel estimation unit for obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, said channel estimation unit comprising:

means for locating the pilot symbols in the combined symbol sequence;

means for generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result;

means for obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks,

wherein a magnitude of weighting differs between at least two data symbols in each slot and the power of the data symbols and pilot symbols is controlled on a slot by slot basis.

6. (**Amended**) The CDMA transceiver as claimed in [any one of claims 3-5] claim 3, wherein said receiving processor further comprises means for extracting, from the data symbol sequence compensated for, the power control symbol sequence for controlling power of the data symbols and pilot symbols, and said means for transmitting the spread combined symbol sequence transmits the spread combined symbol sequence in accordance with the power control symbol sequence.

7. (**Amended**) The equipment as claimed in any one of claims [1-6] 2, 3 and 15, wherein the power of the data symbols and pilot symbols is controlled on a slot by slot basis.

8. (**Amended**) The equipment as claimed in any one of claims [1-7] 1-3 and 15, wherein the number of data symbols included in each slot of the combined symbol sequence is the same, and the number of pilot symbols included in each slot of the combined symbol sequence is the same.

9. (**Amended**) The equipment as claimed in any one of claims [1-8] 1-3 and 15, wherein the pilot blocks each consist of all the pilot symbols in each slot.

10. (**Amended**) The equipment as claimed in any one of claims [1-9] 1-3, wherein when obtaining the channel estimates of the data symbols in an nth slot in the combined symbol sequence, where n is an integer, the pilot blocks are generated from (n-K+1)th slot to (n+K)th slot in the combined symbol sequence, where K is a natural number.

11. (**Amended**) The equipment as claimed in any one of claims [1-10] 1-3 and 15, wherein the pilot blocks closer to the data symbol with which the channel estimate is to be obtained have greater weight.

12. (**Amended**) A channel estimation method of obtaining channel estimates of data symbols from pilot symbols in a combined symbol sequence which has a plurality of slots and includes the data symbols and the pilot symbols, said channel estimation method comprising the steps of:

locating the pilot symbols in the combined symbol sequence;

generating pilot blocks by extracting the pilot symbols from two or more slots in the combined symbol sequence in accordance with a located result; and

obtaining the channel estimates of the data symbols by calculating a weighted sum of averages of the pilot symbols in the individual pilot blocks,

wherein a magnitude of weighting differs between at least two data symbols in each slot, and the power of the data symbols and pilot symbols is controlled on a slot by slot basis.